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The Aberdeen Shallow Water Current Meter Mooring

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Marine Laboratory, Aberdeen

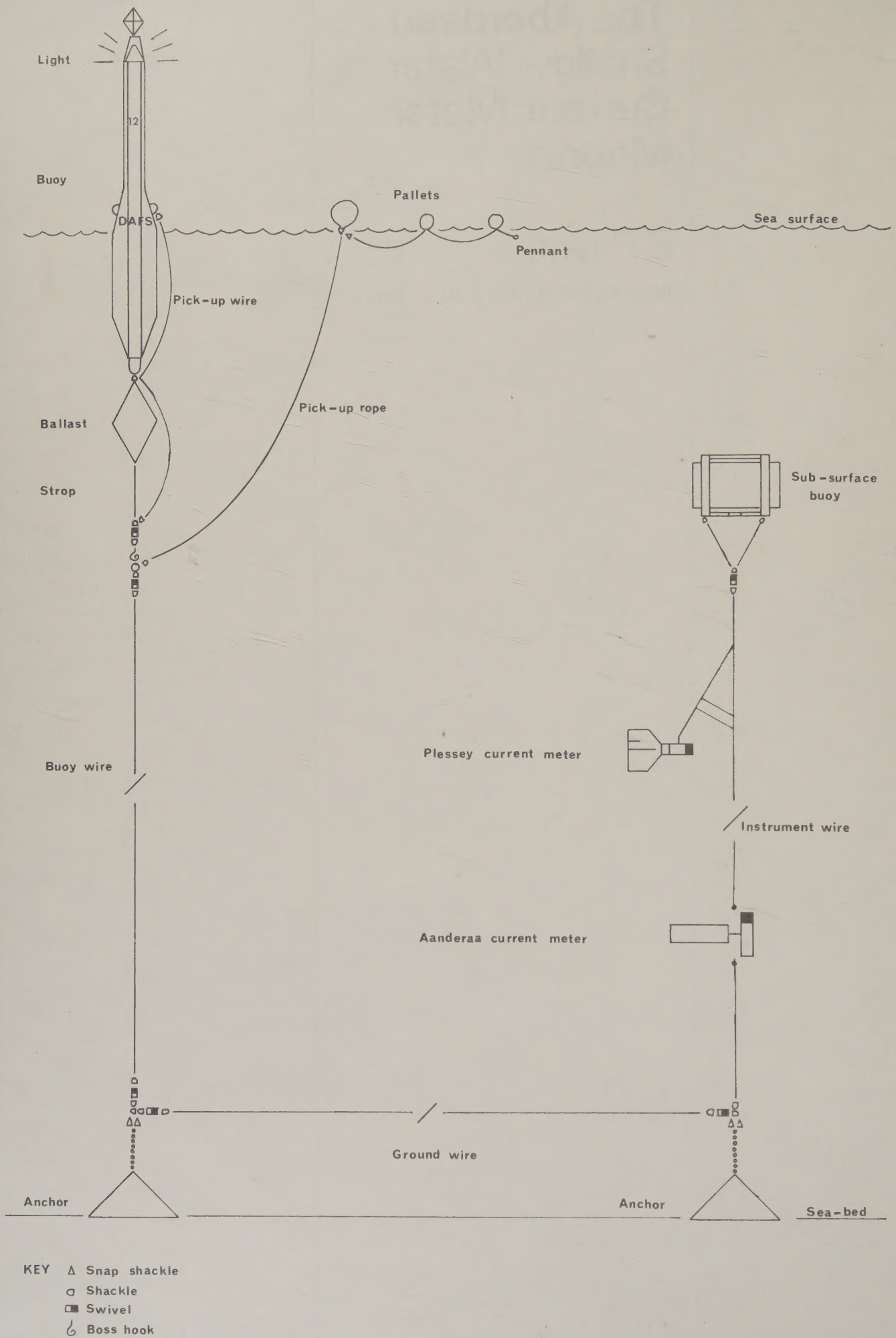

Figure 1. DAFS Marine Laboratory, Aberdeen. Oceanographic Buoy Rig.

Introduction

The shallow water mooring described in this report has been used in the ocean current measurement programme at the Marine Laboratory, Aberdeen, since its conception in June 1967. Since then over 100 standard shallow water moorings have been laid in depths varying from 20 to 300 metres.

Losses directly attributable to mooring failures have been negligible although losses caused by fishing incidents are high (Table I). Normally it is the instrument wire and instruments which suffer heavily in this type of incident.

Instruments used on the rigs include the Aanderaa current meter RCM4, the Plessey current meter MO21 and the Aanderaa thermistor chain TR1.

General Description

The mooring is of the typical 'U' configuration (Fig. 1). A sub-surface buoy, some 30 m below the surface, holds taut an instrument wire to which the instruments are attached. Holding the wire and the sub-surface buoy down is a 385 kg anchor clump of chain. From this clump the ground wire, which has a length equal to twice the depth of water, runs to a further anchor clump of 385 kg, which anchors the surface buoy. This buoy is attached to the anchor by a wire of length equal to twice the depth. The surface buoy is clipped into the rig between the buoy wire and the pick-up rope. The surface buoy is equipped with a flashing light and radar reflector.

This mooring is designed to be installed or recovered in virtually any weather conditions.

The Equipment

The surface buoys

Two different surface buoys are in use, the Valentine buoy and the skittle buoy.

The Valentine Buoy

This is a spar buoy, 2.44 m in length and 610 mm in external diameter, half of which is submerged, made up of two 1.22 m x 610 mm diameter glass reinforced plastic (GRP) cylinders, wall thickness 13 mm minimum with additional thickness at the top and bottom plates and at the central flange. The top plate is Tufnol and the bottom plate is steel. The whole buoy is painted in the standard oceanographic colours of broad fluorescent red and yellow vertical stripes. Gross weight is 186 kg. With the exception of the battery space the buoy is filled with polyurethane foam. The GRP cylinders are manufactured locally by North East Glass Fibre, and the other components are made and assembled by the laboratory workshop.

A Tern beacon is fitted into the top plate of the buoy. This gives at night a bluish-white light from a Xenon discharge tube exhibiting an interrupted quick flashing light showing quick flashes for 5 secs every 20 secs. This is in accordance with the recommendations of the Inter-Governmental Maritime Consultative Organisation. The light is protected by means of a guard fitted over it. The 12V power supply is 2 x 6 V Varley VPT 6/15/30 accumulators in series giving sufficient power for three months on station.

A fitting is available on the top plate for the installation of a transponding radio within the buoy. A seven foot aerial is fitted into the top of the radio compartment and this serves as a useful staff for a red and yellow vertically striped flag. A radar reflector is built in under the top plate in the upper cylinder. The buoy requires 113 kg of ballast hung underneath, less the weight of the buoy wire. Pick-up loops are attached to the top of the buoy and ropes for handling to the bottom.

The Skittle Buoy

This is a skittle-shaped spar buoy 6 m long, 2.4 m of which is submerged. The central tube is of Durapipe covered with GRP; buoyancy chambers are built around the pipe and the whole covered in GRP and rounded. The buoyancy chambers are filled with polyurethane foam. Above the waterline the buoy is also painted in broad fluorescent red and yellow vertical stripes, and below the water line fluorescent red only. Gross weight is 215 kg. The buoy is manufactured by Reinforced Plastic Structures Ltd of Lancing, Sussex.

The light used with this buoy is the Autronica LE4 set to flash 0.3 secs on, 3.0 secs off. A 0.5 or 0.25 A bulb is fitted giving a 3 or 1.5 W light. Two spare bulbs are carried on an automatic lamp changer. A photo-electric cell is fitted and the light is protected by a guard.

A power supply of 18 V is required, which is stepped down by the light unit to 6 V. The manufacturer supplies a battery pack of dry batteries but the laboratory has converted these packs to accept 3 x 6 V Varley VPT 6/15/30 accumulators in series giving sufficient power for approx 40 days. A smaller bulb can be fitted to increase the duration if required. Ample space is available to increase the power supply should it be necessary. The battery pack is located at the bottom of the buoy and is reached by removing the light. A metal tube can then be withdrawn bringing the battery pack up and out of the buoy.

The buoy requires 192 kg of ballast hung underneath, less the weight of the buoy wire.

The sub-surface buoy

This is a hollow, barrel-shaped unit made of GRP. It is 1 m long by 700 mm in diameter, built up on the mould for a liferaft housing. A frame of galvanised steel, consisting of two rings with connecting bars top and bottom, is fitted round the buoy. The manufacturer is North East Glass Fibre, Aberdeen.

Initially the buoys were made of GRP not less than 8 mm thick, but these early models showed a tendency to hair-line fracture. Later models were made of GRP not less than 16 mm thick, weighing approx 91 kg and giving a net buoyancy of 181 kg.

The normal working depth of this buoy is 30 m, although depth testing shows they would be safe to 100 m. A recent test revealed a pin-hole fracture after immersion to 150 m.

The wires and splices

The specification for the buoy and ground wires is:

13 mm diameter, 18 by 7, fibre main core, right hand ordinary lay, preformed, "Kilindo", 180 kgf per mm^2 (115 tons f per in^2), galvanised wire with a breaking strain of 9.14 tonne and a safe working load (SWL) of 1.93 tonne.

The instrument wire is either 7 mm diameter stainless steel wire or 8 mm diameter galvanised wire. The specifications are:

7 mm diameter, 17 by 7, wire main core, right hand ordinary lay, Beacon prelay preformed, 100/110 TPS1 non-corrodible stainless steel, "Kilindo" non-rotating wire with a breaking strain of 2.13 tonne and a SWL of 0.35 tonne.

8mm diameter, 18 by 7, fibre main core, right hand ordinary lay, preformed, 180 kgf per mm^2 (115 tons f per in^2), galvanised, "Kilindo", multi strand, non rotating wire with a breaking strain of 3.65 tonne and a SWL of 0.72 tonne.

The strop beneath the buoy, termed the buoy strop, is made up from 18 mm diameter galvanised wire, with the following specification:

18 mm diameter, 6 by 19, fibre main core, right hand ordinary lay, 145 kgf per mm^2), galvanised wire with a breaking strain of 14.2 tonne and a SWL of 3 tonne.

This strop enables the buoy to be connected to the rig before the buoy is lifted over the side of the ship. The distances between the gallows and the buoy, and between the gallows and the waterline, are factors determining the length of this strop, which is usually 5 m.

The pick-up wire, which is required when working buoys from a high-sided ship the working deck of which is 5 m from the waterline, is made of the same wire as the buoy and ground wires and is normally 15 m in length.

All these wires are purchased from Bruntons of Musselburgh. The splices are made by the Talurit method using copper ferrules and a thimble, galvanised or stainless steel depending on the wire material. All the Talurit splices are doubled using two copper ferrules at each end. The wires are made up and spliced in the laboratory's rigging shop. Four aluminium Talurit ferrules are placed 30 cm from the end of every wire. These serve no splicing function but act as sacrificial anodes protecting each connection.

The anchors

These are made up from used scrap 25 mm or 32 mm stud-link cable and weigh ca 360 kg. The cable is cut into eight lengths each weighing approximately 45 kg and a 2 m length of 9.5 mm chain with a 13 mm diameter ring at each end and in the centre is threaded through the end of each length of cable. The end that has been passed through is brought back to the centre ring and shackled with a large bow shackle. This gives a neat clump with a 1 m tail for attachment to the mooring. The large bow shackle is used for lifting and stopping off the anchor during shooting or hauling operations.

The ballast chains

These are also made up from 25 mm or 32 mm used scrap stud-link cable. The cable is cut into lengths by weight, eg 1.5 m weighs approximately 23 kg and 3 m approximately 46 kg. A number of lengths from 1.5 m to 6 m are kept in stock and the appropriate amount of chain is shackled to the bottom of the buoy to give the correct ballast for each situation.

The ropes

The pick-up rope is 30 m in length and made up from 24 mm diameter nylon with a hard eye hand-spliced in each end. Nylon, which has negative buoyancy, has been found to be preferable to polypropylene or other positively buoyant ropes since these have a tendency to become entangled with the buoy and ballast chains.

The pennant, which is purely an aid to the retrieval of the pick-up rope, is made from 12 mm diameter polypropylene rope to ensure it will float along its length and provide an easy target for the grapnels. It is 20 m long with a pallet in the centre and one at the tail, the other end being snap-shackled to the pick-up rope and pallet. A galvanised thimble is hand-spliced into each end.

A thin polypropylene rope of 8 mm diameter fitted with a weak link of 3 mm diameter, is attached to the top of the sub-surface buoy and leads to a 760 mm circumference pallet at the surface. This enables the position of the sub-surface buoy to be checked periodically and also acts as an aid

in shooting. The weak link prevents anyone picking up the sub-surface buoy and instruments by this rope.

The pallets

The 1.25 m circumference pick-up pallet is attached to the end of the pick-up rope by a snap-shackle. It gives ample buoyancy to the end of the pick-up rope and also sufficient drag and windage to keep the rope clear of the buoy and ballast chains.

Two 0.76 m circumference pallets are lashed to the centre and tail of the pennant.

The shackles

On the buoy and ground wires all shackles are galvanised and have a 19 mm pin-diameter. They are drilled through the shoulder to accept a 3 mm x 63 mm stainless steel split pin and marked across the shoulder and end of the pin to allow for easy alignment when assembling. Experience with long term moorings showed most seizing wires to be badly affected by corrosion, and the practice of pinning all shackles of suitable size was adopted.

The instrument wire shackles for the stainless steel wire are of stainless steel and have a 12 mm pin-diameter. For galvanised wire they are galvanised and have a 12 mm pin-diameter. All shackles are drilled and pinned with a 2.4 mm x 50 mm stainless steel split pin.

Shackles on the stainless steel sub-surface buoy strops have a 6 mm pin-diameter and are of stainless steel. They are heavily seized with tinned copper or monel wire which shows reasonable resistance to corrosion. The 6 mm shackles are too small to be drilled and pinned satisfactorily.

All the above shackles are of 'D' configuration.

The attachment of the pick-up pallet, the pennant and the anchors is effected by the use of stainless steel or manganese bronze snap shackles, which are doubled for safety on the anchors. Their use greatly facilitates the rapid engaging and disengaging of these connections.

The swivels

The swivels are made of stainless steel and are purchased from Frekhaug Metallstopperi in Norway. Two sizes are used, 5 tonne SWL for the buoy and ground wires and 3 tonne SWL for the instrument wire. These swivels may be easily stripped down after each mooring, cleaned, greased and reassembled.

At the bottom of the buoy wire and connecting with the ground wire the two swivels are joined together with three welded shackles, the anchor clipping into the centre shackle. These double swivel units are termed "link swivels".

The Boss 20 hook

This is a stainless steel purse seine hook and is used for the attachment of the buoy to the mooring. One side of the hook is a spring-loaded sleeve enabling it to be easily opened or shut whilst remaining completely secure in situ.

The manufacturer is Frekhaug Metallstopperi of Norway.

Wire Storage and Handling

All wires are stored individually on cable drums. Some were made specifically for this job; the remainder came from a source of ex-government equipment and have the advantages of being cheap, robust and of a useful size. Each wire length is labelled, using segments cut from used Woodhead sea-bed drifters, the lengths being "engraved" into the plastic with a soldering iron and filled in with yellow paint. This makes a very useful, legible and hardy label.

A stock of wires is thus built-up, lengths being used repeatedly until adjudged to have reached the end of their useful lives, whereupon they are scrapped.

To enable wires to be run off onto the winch and also rewound off the winch onto the drums a device based upon the commercially obtainable Rolladrum is used. The Rolladrum consists of a flat base with a ramp at the front and two rollers. one of which is adjustable to accommodate different diameters of drums. The drum is placed in an upright position on the rollers and the wire is pulled off, causing the drum to rotate upon the two rollers. The basic unit has been adapted by fitting a frame with handles and a "V" belt drive to one of the rollers, enabling the Rolladrum to be used to wind cable back onto the reels simply by rotating the one roller which in turn rotates the cable drum. This device has worked well and is very stable in rough conditions at sea.

Special Rigs

For moorings in very shallow water, or moorings that have to be handled from very small boats, special rigs are designed. The "U" configuration is kept wherever possible, but ropes are substituted for wires, pallets for surface buoys etc, in an endeavour to reduce the weight and bulk involved and facilitate the handling of the equipment. The majority of these special rigs for current meters and thermistor chains have been laid in Loch Thurnaig at Loch Ewe, providing valuable information owing to the high rate of corrosion in metals experienced there.

Corrosion

Although always noticeable, corrosion did not become a problem until 1969, when the laboratory started to maintain a long term mooring off Collieston on the Scottish east coast. It soon became evident that aluminium Talurit ferrules were not hard enough to resist the rapid corrosion rates, one submerged for two months practically disappearing. Double copper ferrules were substituted on all the wires, both stainless and galvanised. In addition, 30 cm from the end of every wire four aluminium ferrules are added to act as sacrificial anodes. A 3 kg anode is fitted to both the base-plate of the surface buoy and the lower bar of the subsurface buoy. No appreciable corrosion has occurred since these precautions were taken, though the anodes have to be regularly replaced. Tests at Loch Ewe supported the change to copper ferrules and the fitting of sacrificial anodes to the wires and buoys.

The use of Kimeplate rust converter as a base on metals before painting has also been most successful in reducing the corrosion and subsequently maintaining metal parts.

Attachment of the Thermistor Chain

This instrument, manufactured by Aanderaa, consists of a recording unit similar to that of the current meter and an oil filled tube 20 m or 50 m long containing eleven thermistors. It is not supplied with attachments for the recording unit or the chain. This necessitated the design and construction of a clamp which was based on the Plessey A-frame stopper to hold the recording unit. The tube is secured to the wire with large plastic, self-locking cable ties.

Navigational Warnings

At least one month before the installation of a mooring the following organisations are informed of its planned position:

a. the Admiralty, who issue a "Notice to Mariners",
b. the Department of Trade and Industry, and
c. the Northern Lighthouse Board.

Details of positions are also sent to 48 other organisations including coastguards, harbour masters and fishery officers in Britain and appropriate organisations in coastal countries of Western Europe and they are later issued with "Notices to Fishermen" to distribute locally. In certain circumstances other organisations are notified as appropriate. Fishery Offices also distribute posters amongst their local boats. In addition the Marine Laboratory fish market team distribute notices and posters in Aberdeen Fish Market. Exceptionally, warnings are broadcast by the local radio stations, or a Naveam is issued by the Admiralty.

The Installation and Recovery of a 'U' Mooring

Preparations for shooting from a side trawler

A wire messenger of sufficient length to run through the deck bollards out of the forward gallows block and back amidships is fed onto the empty port drum of the trawl winch. The tail of the pick-up rope is shackled to this messenger and is winched on. The ring and swivel assembly is then attached, followed by the buoy wire, which is fed onto the winch from the Rolladrum. A link swivel is shackled in and the ground wire run off the Rolladrum onto the winch, followed by a further swivel and the instrument wire. If a Plessey current meter is to be used the stopper is attached at the appropriate place before winding onto the winch. All wires and ropes with the exception of the pennant and buoy strop are now on the winch and all shackles are pinned except for the joining shackles where an Aanderaa current meter is to be placed. It will be assumed for the purposes of illustration that the rig is instrumented as shown in Figure 1, ie a Plessey current meter a short distance under the sub-surface buoy and an Aanderaa current meter a short distance above the instrument wire anchor.

The tail of the instrument wire is passed through the deck bollards, out through the starboard forward gallows block, and back onto the deck. The sub-surface buoy complete with strops and swivel is placed under the yo-yo derrick and the tail of the instrument wire is shackled to it and pinned. If used, the rope for the surface pallet at the sub-surface buoy is shackled to the top bar. A snatch block is clipped onto the instrument wire and secured near the trawl winch, giving the instrument wire a clear lead down the deck on the starboard side.

The buoy light is checked and the buoy positioned against the starboard rail with the light facing aft. When a Valentine buoy is being used the centre flange fastenings are tightened to allow for any take-up in the gasket. The appropriate amount of chain ballast is added and the buoy strop, swivel and Boss 20 hook shackled on. The end of the buoy strop with the Boss 20 hook is passed forward outside any rigging to a position underneath the forward gallows.

The anchors are lifted by the gilson and hung on 19 mm diameter rope stoppers fore and aft of the gallows. Two snap shackles are fitted to the tail of the link chain of each anchor.

The yo-yo derrick is positioned to give an adequate clearance for equipment outside the ships rail and the pick-up pallet and pennant are laid near the forward gallows.

The instruments are brought out and laid near the yo-yo derrick. A 230 mm outside diameter rope grommet made of 8 mm diameter polypropylene is fitted to each meter to enable the yo-yo hook to get a firm hold and ensure a smooth release.

Shooting from a side trawler

The ship is stopped with the starboard side to the wind or tide, the position checked by Decca, or radar or both, and the depth noted. The sub-surface buoy is lifted over on the yo-yo wire, the hook being disengaged when the buoy is in the water. The instrument wire is then pulled off by hand through the bollards and block and aft along the deck, through the snatch block and over the side. As the Plessey stopper comes along the deck it is stopped off under the yo-yo derrick and the "A" frame and meter are fitted to the stopper and wire. The meter is picked up in the grommet by the yo-yo hook, the snatch block repositioned on the wire behind the meter and the whole lifted up and over the side. When the meter is in the water the hook is disengaged. The wire continues to be paid off the winch and the snatch block is repositioned at the trawl winch. As the shackle joining the wire where the Aanderaa current meter is to be positioned reaches the derrick it is halted, the wire is stopped off, the shackle broken and the Aanderaa placed into the wire and shackled and pinned. The current meter is picked up in the grommet by the yo-yo hook, the stopper let go and

the snatch block removed entirely. The meter is lifted over the side and the hook disengaged in the water. The instrument wire is paid off until the first swivel reaches just outboard of the gallows block. The instrument wire now runs directly from the gallows block in a shallow bight out to the sub-surface buoy, which will have drifted some distance away.

The first anchor is shackled to the first 19 mm pin-diameter shackle, and the rope stopper slowly slackened off until the wire and winch take the whole weight. The ground wire is then paid out, a Decca position being taken as the first anchor reaches the bottom. This position is noted on the Current Meter Mooring Sheet (Appendix I).

The clutch is then taken out of the winch and the ground wire allowed to pull off as the ship drifts down wind or tide. This is to enable the ground wire to be stretched out in a straight line rather than loosely in a series of loops which might allow the buoy wire scope to approach the instrument wire and become foul during the period of the mooring. The wire continues to pull off until the link swivel is just outboard of the block. The clutch is put in the winch and the brake applied. The ground wire is then stretched using the weight of the driving ship.

The second anchor is shackled in to the centre shackle of the link swivel and the rope stopper eased as before. Paying out of the buoy wire commences until the anchor reaches the bottom. A position is taken and noted as before.

The remaining wire is paid out swiftly until the ring is just outboard of the block. The after anchor stopper is threaded through the ring and pulled tight. The Boss 20 hook is lifted and snapped into the ring, and the buoy raised on the yo-yo hook up and over the side. Once the buoy is in the water the hook is slipped. At this point the buoy, without the weight of wire on it, lies horizontally on the water. The pick-up rope is run swiftly off the winch, and the end is unshackled from the messenger and hauled swiftly by hand through the bollards and block. The pennant and pick-up pallet are snapped onto the end of the pick-up rope. The stopper is let go, the pick-up rope is paid out and the buoy attains the vertical as the weight of the buoy wire is felt. The drive of the ship pulls off the last of the pick-up rope, the pallet and finally the pennant. The entire mooring is now in position.

Preparations for hauling

The tail of the messenger is run off the port drum through the bollards and foward gallows block and run aft to amidships on the starboard side. The yo-yo hook is taken off the derrick wire and a grab boat hook and pole shackled on. This is a type of eyed hook on a 3 m pole, such that, when a firm grip with the hook has been obtained in the lifting handle or eye of a buoy, a spring loaded gate snaps over the gap of the hook. Then, with a sharp tug, the handle may be withdrawn, leaving the hook securely attached to the buoy and connected to the ship by the yo-yo wire. The gilson wire is made ready near the fore gallows to hoist in the anchors. A snatch block is made ready near the derrick for use in recovering the instruments. Grapnels are placed along the starboard rail.

Hauling

The ship moves at dead-slow up wind or up tide to the buoy and a grapnel is thrown between the pallets of the pennant. The pennant is hauled in until the end of the pick-up rope is secured. The messenger is shackled into the pick-up rope and the pick-up pallet and pennant are disengaged. The rope is put back over the side and hauling commences through the forward gallows block. The Boss 20 hook and ring are stopped just outboard of the block and the grab boat hook on the yo-yo wire is secured in the lifting eye of the buoy. The handle is pulled away, and the buoy is lifted on board by the yo-yo derrick and secured at the starboard rail, light facing aft. The Boss 20 hook is unsnapped and hauling continues.

After the buoy anchor breaks surface and when the link swivel and double

snap shackles are just outboard of the main block hauling stops. The gilson wire is shackled into the anchor and is hauled in to take the strain. The snap shackles are then disengaged, and the gilson pulls the clump aboard through the gallows. Alternatively, the anchors may be secured on the rope stoppers and brought inboard later. Hauling of the ground wire then begins and the instrument wire anchor is similarly brought aboard or secured.

At this juncture a large snatch block replaces the grab boat hook on the yo-yo wire and is clipped into the instrument wire. The snatch block is hauled to the top of the derrick. Hauling commences again on the main winch and the Aanderaa current meter rises vertically out of the water; clear of the ships side, to a position above the ships rail. The yo-yo wire is slacked off and the meter brought in over the rail. The instrument wire is stopped off at the rail, the current meter is taken out of the wire and the wire reshackled. The Plessey current meter is recovered in a similar way, as is the sub-surface buoy.

The entire mooring is now on board.

Clearing Up

The wires are run off the winch onto the appropriate reel using the Rolladrum. A careful inspection of the wire, Talurits, anodes etc is carried out during this operation. All ropes and wires are labelled with their length and condition. All other equipment is dismantled and stored away. Maintenance of the equipment is carried out ashore (See Appendix II).

Restriction

Only one restriction has arisen in the use of this mooring. It has been found that if an Aanderaa current meter is placed closer than 10 m above the anchor it is almost invariably recovered with a bent frame. It is probable that the long fin of the Aanderaa becomes entangled with the slack of the ground wire when the anchor strikes the sea-bed during initial shooting, with inevitable distortion when strain comes on the wire.

Table I

Mooring Effort and Losses

1967	Total effort 63 buoy days, 12 moorings Losses – 1 Valentine buoy 10.9.67, swivel failure.
1968	Total effort 158 buoy days, 11 moorings Losses – 2 Plesseys 29.5.68, splice failure – 2 Plesseys 6.11.68, suspected fishing incident
1969	Total effort 274 buoy days, 12 moorings Losses – 1 Valentine buoy, 24.9.69, suspected fishing incident. (Recovered later)
1970	Total effort 541 buoy days, 20 moorings Losses – 1 Aanderaa and 1 Plessey 12.12.70, suspected fishing incident – 1 Plessey and sub-surface buoy 31.8.70, definite fishing incident.
1971	Total effort 242 buoy days, 14 moorings Losses – 1 Plessey and Valentine buoy 11.1.71, definite fishing incident – 1 Valentine buoy 11.1.71, definite fishing incident.
1972	Total effort 554 buoy days, 20 moorings Losses – 1 Plessey 30.5.72, 1 Aanderaa 30.5.72, suspected fishing incident – 1 Plessey 30.5.72, suspected fishing incident – 1 Valentine buoy 3.10.72, buoy wire cut, presumably on wreck nearby. (Recovered later)
1973	Total effort 591 buoy days, 23 moorings Losses – 1 Aanderaa 19.4.73, suspected fishing incident.

Appendix I
Current Meter Mooring Sheet

POSITION	Lat			Long			
DECCA	Red		Green		Purple		
AREA							
DATE		TIME		RADIO			
DEPTH		Surface Buoy Number		Sub-surface buoy Number			
Buoy wire		Ground Wire		Instrument Wire		Ballast Chain	
1st Anchor	Red		Green		Purple		
2nd Anchor	Red		Green		Purple		
Current Meter	Serial No. Ref. No.		Depth		Sampling Interval		Record
Power Pack No.	HR BST	Tape Begins Date		HR BST	Set Date		
Last Reading	HR BST	Water Date			Tape Date		
Current Meter	Serial No. Ref. No.		Depth		Sampling Interval		Record
Power Pack No.	HR BST	Tape Begins Date		HR BST	Set Date		
Last Reading	HR BST	Water Date		HR BST	Tape Date		
Current Meter	Serial No. Ref. No.		Depth		Sampling Interval		Record
Power Pack No.	HR BST	Tape Begins Date		HR BST	Set Date		
Last Reading	HR BST	Water Date		HR BST	Tape Date		
Guard Dhan	Red	Green	Purple	Marks			
Guard Dhan	Red	Green	Purple	Marks			
Guard Dhan	Red	Green	Purple	Marks			
Hauled	HR BST	Date					

Remarks — See over

Appendix II
Buoy Section

Maintenance Schedule	Carefully examine **all** components. Report damage or uncertainty to Mr Payne
Buoys	Lights to room 313 Light gaskets to room 313 Radar reflectors to room 313 Accumulators, clean, to workshop Leads, clean, to room 313 Check anodes. Replace as necessary Clean flanges Check paint and renew as necessary, including base plate Check ropes and lifting eyes Check aerials and flags. Replace as necessary Bolts, nuts and washers, clean and oil Check that reward label is present on Valentine Check radio cylinders on Valentines for dryness and re-seal Check that at least 6 Valentine gaskets are held in stock
Sub-surface buoys	Take off shackles, wires and swivel. Clean Check buoy and frame. Clean Paint buoy and frame as necessary Check anode, clean and replace if necessary
Ballast Chains	Take off shackles, swivels, Boss 20s. Clean Repaint length marks as necessary
Anchors	Take off shackles and snap-shackles. Clean Check link chains for excessive corrosion
Wires	Check that all wires are correctly labelled Take off shackles, Boss 20s etc.
Drums	Check drums for damage, repair as necessary Repaint as necessary
Pick-up Ropes	Take off shackles, rings and swivels except for single shackle at top end Wash if necessary Dry and coil
Pennants	Oil snap shackle (Keep oil off the rope) Check pallets for inflation Paint legends as necessary Wash if necessary Dry and coil
Pick up pallets	Take off shackles and snap-shackles. Clean Check pallets for inflation Paint legends as necessary
Link swivels and swivels	Remove extra shackles etc Clean, dismantle and regrease (PBC) swivels Check action of swivels

Snap-shackles	Wash, clean and oil Check rings Check that snaps do snap and un-snap easily
Shackles	Wash, clean and oil Check for excessive wear and corrosion All ¾ in D shackles and ½ in shackles should be drilled for appropriate split pins and marked
Rolladrum	Check belt and action Clean and oil moving parts Repaint as necessary
Ropes	Dry and coil Remove any shackles etc Label
Pallets—all sizes	Remove shackles etc Check for inflation Paint legends as necessary
Boss 20s	Clean and grease (PBC)
Snap boat hook	Clean and oil Check that 2 poles are in stock
Snatch Blocks	Clean and oil
General	Check all boxes for dirty components and clean Store all components in appropriate places If extra labour is required contact Mr Martin or Mr Payne Keep stores tidy as far as possible

RE 37582 400 5/75 TCL